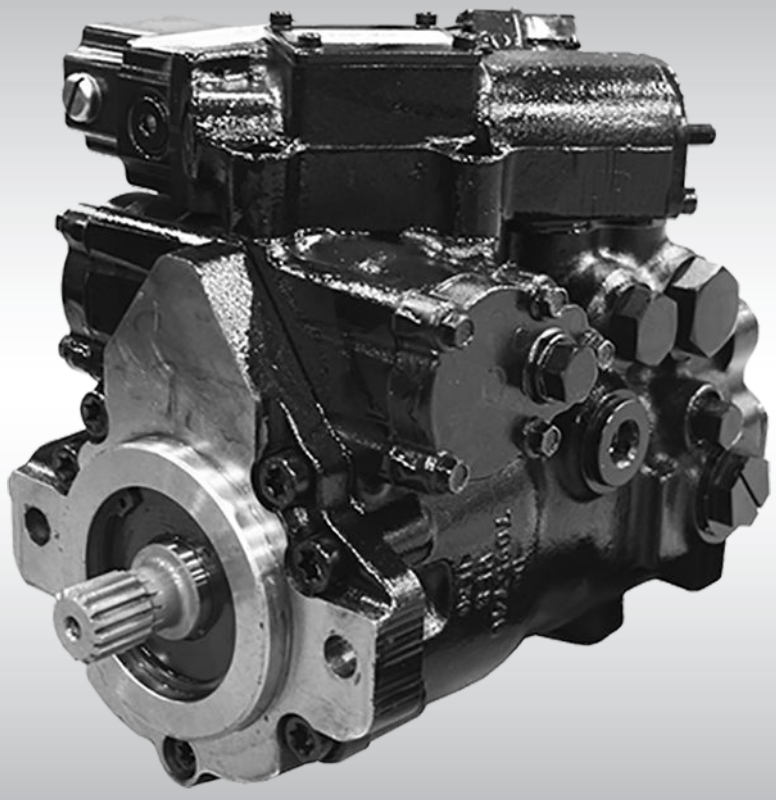
MAKING MODERN LIVING POSSIBLE

Service Manual

Series 40 M46
Variable Pumps



Revision History

Table of Revisions

Date	Changed	Rev
April 2014	Danfoss layout	BA
October 2010	corrections to port location illustration	AE
March 2010	Fix Osaka address	AD
March 2009	added spool alignment illustration	AC
May 2008	Fixed the illustrations	AB
October 2007	First edition	AA

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Introduction

Overview

This manual includes information for the installation, maintenance, and minor repair of the Series 40 M46 pump. It includes a description of the unit and its individual components, troubleshooting information, and minor repair procedures.

Performing minor repairs requires the unit to be removed from the vehicle/machine. Thoroughly clean the unit before beginning maintenance, or repair activities. Since dirt and contamination are the greatest enemies of any type of hydraulic equipment, follow cleanliness requirements strictly. This is especially important when changing the system filter and when removing hoses or plumbing.

A worldwide network of Danfoss Global Service Partners is available for major repairs. Danfoss trains Global Service Partners and certifies their facilities on a regular basis. You can locate your nearest Global Service Partner using the distributor locator at www.powersolutions.danfoss.com.

Warranty

Performing installation, maintenance, and minor repairs according to the procedures in this manual will not affect your warranty. Major repairs requiring the removal of a unit's front flange voids the warranty unless done by a Danfoss Global Service Partner.

General instructions

Follow these general procedures when repairing Series 40 M46 variable displacement closed circuit pumps.

Remove the unit

Prior to performing repairs, remove the unit from the vehicle/machine. Chock the wheels on the vehicle or lock the mechanism to inhibit movement. Be aware that hydraulic fluid may be under high pressure and/or hot. Inspect the outside of the pump and fittings for damage. Cap hoses and plug ports after removal to prevent contamination.

Keep it clean

Cleanliness is a primary means of assuring satisfactory pump life, on either new or repaired units. Clean the outside of the pump thoroughly before disassembly. Take care to avoid contamination of the system ports. Cleaning parts using a clean solvent wash and air drying is usually adequate.

As with any precision equipment, keep all parts free of foreign materials and chemicals. Protect all exposed sealing surfaces and open cavities from damage and foreign material. If left unattended, cover the pump with a protective layer of plastic.

Replace all O-rings and gaskets

Danfoss reccommends you replace all O-rings, seals, and gaskets during repair. Lightly lubricate all O-rings with clean petroleum jelly prior to assembly.

Safety precautions

Always consider safety precautions before beginning a service procedure. Protect yourself and others from injury. Take the following general precautions whenever servicing a hydraulic system.

Introduction

Unintended machine movement

Warning

Unintended movement of the machine or mechanism may cause injury to the technician or bystanders. To protect against unintended movement, secure the machine or disable/disconnect the mechanism while servicing.

Flammable cleaning solvents

Warning

Some cleaning solvents are flammable. To avoid possible fire, do not use cleaning solvents in an area where a source of ignition may be present.

Fluid under pressure

Warning

Escaping hydraulic fluid under pressure can have sufficient force to penetrate your skin causing serious injury and/or infection. This fluid may also be hot enough to cause burns. Use caution when dealing with hydraulic fluid under pressure. Relieve pressure in the system before removing hoses, fittings, gauges, or components. Never use your hand or any other body part to check for leaks in a pressurized line. Seek medical attention immediately if you are cut by hydraulic fluid.

Personal safety

Warning

Protect yourself from injury. Use proper safety equipment, including safety glasses, at all times.

Hazardous material

Warning

Hydraulic fluid contains hazardous material. Avoid prolonged contact with hydraulic fluid. Always dispose of used hydraulic fluid according to state, and federal environmental regulations.

Symbols used in Danfoss literature

WARNING may result in injury

CAUTION may result in damage to product or property

Reusable part

Non-reusable part, use a new part

Non-removable item

Option – either part may exist

Superseded – parts are not interchangeable

Introduction

Measurement required

Flatness specification

Parallelism specification

External hex head

Internal hex head

Torx head

O-ring boss port

Tip, helpful suggestion

Lubricate with hydraulic fluid

Apply grease/petroleum jelly

Apply locking compound

Inspect for wear or damage

Clean area or part

Be careful not to scratch or damage

Note correct orientation

Mark orientation for reinstallation

Torque specification

Press in – press fit

Pull out with tool – press fit

Cover splines with installation sleeve

Pressure measurement/gauge location or specification

The symbols above appear in the illustrations and text of this manual. They are intended to communicate helpful information at the point where it is most useful to the reader. In most instances, the appearance of the symbol itself denotes its meaning. The legend above defines each symbol and explains its purpose.

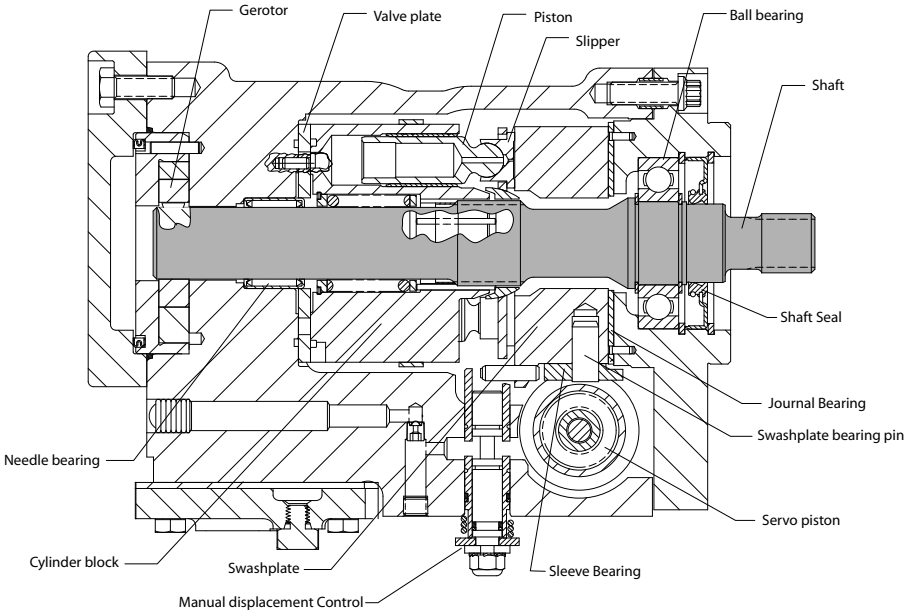
Introduction

Design

Danfoss Series 40 M46 closed-circuit axial-piston pumps convert input torque into hydraulic power. The input shaft transmits rotational force to the cylinder block. Bearings at the front and rear of the pump support the input shaft. Splines connect the cylinder block to the input shaft. A lip-seal at the front end of the pump prevents leakage where the shaft exits the pump housing. The spinning cylinder block contains seven reciprocating pistons. A ball joint connects a brass slipper to each piston. A spring washer and the force of charge pressure holds the slippers to the swashplate. The reciprocating movement of the pistons occurs as the slippers slide against the inclined swashplate during rotation. Via the valve plate, one half of the cylinder block connects to low pressure and the other half to high pressure. As each piston cycles in and out of its bore, fluid displaces from inlet to outlet imparting hydraulic power into the system. A small amount of fluid flows from the cylinder block/valve plate and slipper/swashplate interfaces for lubrication and cooling. The pump also uses excess flow from the charge pressure relief valve for cooling. Case drain ports return this fluid to the reservoir. A gerotor-style charge pump provides this flow and maintains a minimum pressure in the system loop.

The angle of the swashplate controls the volume of fluid displaced into the system. The servo piston sets swashplate angle. The pump control modulates servo piston position by varying differential pressure across the piston.

Cross section view



The system circuit

The basic closed circuit

Hydraulic lines connect the main ports of the pump to the main ports of the motor. Fluid flows in either direction from the pump to the motor and back in this closed circuit. Either of the hydraulic lines can be under high pressure. In pumping mode the angle of the pump swashplate determines which line is high pressure as well as the direction of fluid flow.

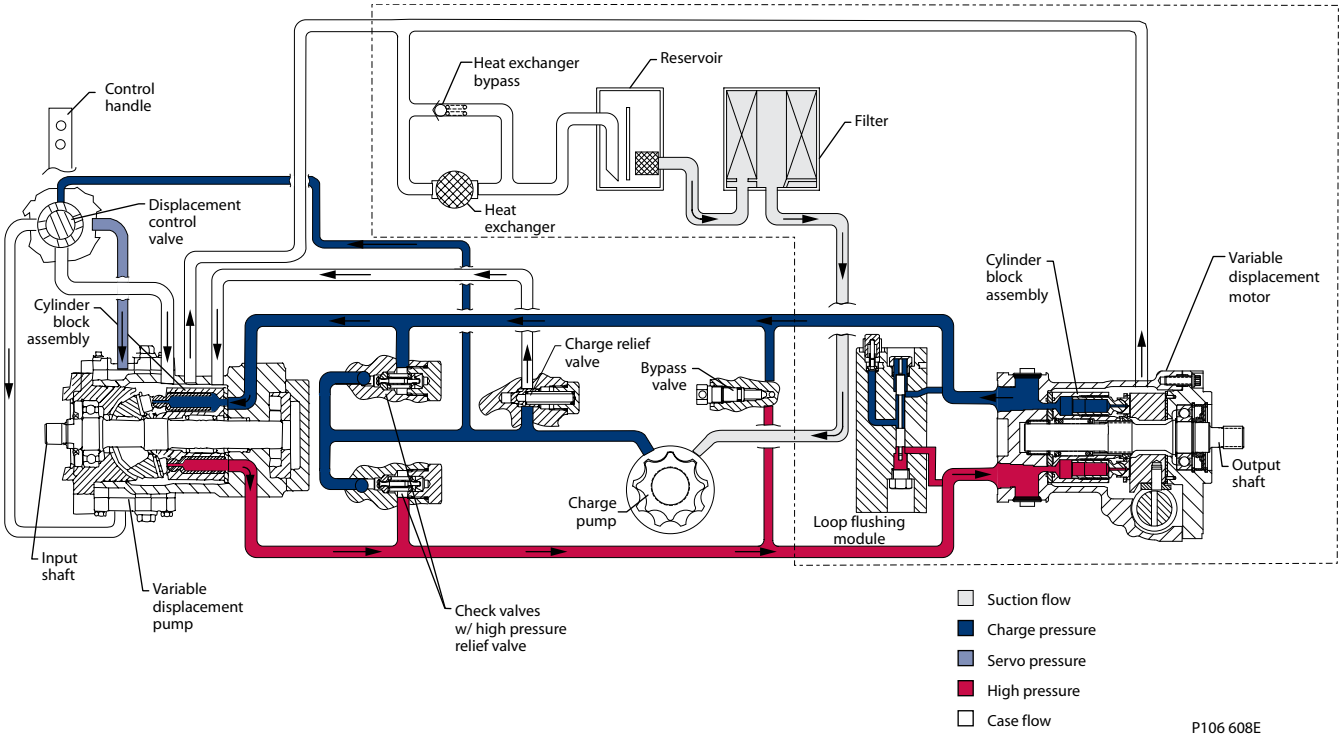
Case drain and heat exchanger

The pump and motor require case drain lines to remove hot fluid from the system. The pump and motor should be drained from their top most drain port to ensure the case remains full of fluid. Flow from the motor case drain may route to the lower drain port on the pump housing and out the top most port, or

Introduction

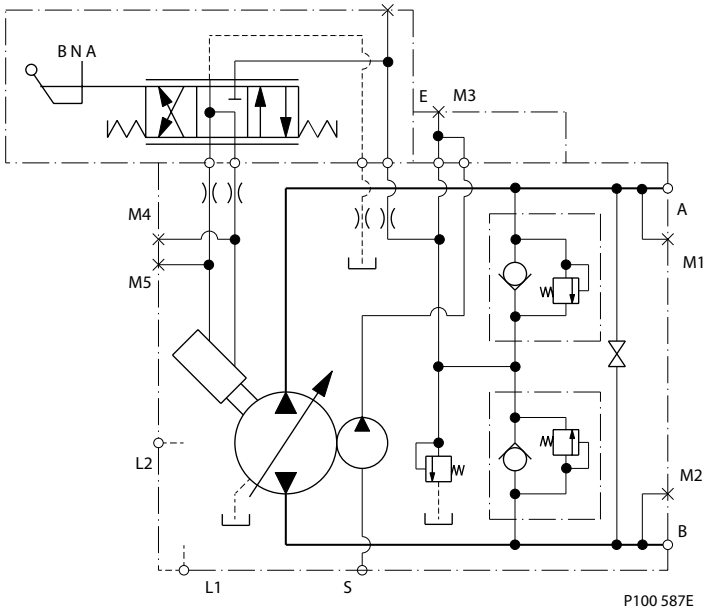
feed directly to the heat exchanger. The system requires a heat exchanger with a bypass valve to cool the case drain fluid before it returns to the reservoir.

System circuit diagram



Pump schematic

Pump schematic



Above schematic shows the function of a Series 40 M46 axial piston variable displacement pump.

Fluid and filter maintenance

Fluid and filter recommendations

To ensure optimum life, perform regular maintenance of the fluid and filter. Contaminated fluid is the main cause of unit failure. Take care to maintain fluid cleanliness when servicing.

Check the reservoir daily for proper fluid level, the presence of water, and rancid fluid odor. Fluid contaminated by water may appear cloudy or milky, or free water may settle in the bottom of the reservoir. Rancid odor indicates the fluid was exposed to excessive heat. Change the fluid immediately if these conditions occur. Correct the problem immediately. Inspect vehicle for leaks daily.

Change the fluid and filter per the vehicle/machine manufacturer's recommendations or at these intervals:

We recommend first fluid change at 500 hours.

Caution

High temperatures and pressures accelerate fluid aging. More frequent fluid changes may be required.

Change the fluid more frequently if it becomes contaminated with foreign matter (dirt, water, grease, etc.) or if the fluid is subjected to temperature levels greater than the recommended maximum.

Dispose of used hydraulic fluid properly. Never reuse hydraulic fluid.

Change filters whenever you change the fluid or when the filter indicator shows that it is necessary to change the filter. Replace all fluid lost during filter change.

Fluid and filter change interval

Reservoir type	Max oil change interval
Sealed	2000 hours
Breather	500 hours

Hazardous material

Warning

Hydraulic fluid contains hazardous material. Avoid contact with hydraulic fluid. Always dispose of used hydraulic fluid according to state, and federal environmental regulations.

Initial startup procedures

General

Follow this procedure when starting-up a new pump installation or when restarting an installation in which the pump was removed. Ensure pump is thoroughly tested on a test stand before installing.

Warning

Unintended movement of the machine or mechanism may cause injury to the technician or bystanders. To protect against unintended movement, secure the machine or disable/disconnect the mechanism while servicing.

Prior to installing the pump, inspect for shipping damage.

Start-up procedure

1. Ensure the machine hydraulic oil and system components (reservoir, hoses, valves, fittings, and heat exchanger) are clean and free of any foreign material.
2. Install new system filter element(s) if necessary. Check that inlet line fittings are properly tightened and there are no air leaks.
3. Install the pump. Install a 50 bar [1000 psi] gauge in the charge pressure gauge port M
4. Fill the housing by adding filtered oil in the upper case drain port. Replace plug.
5. Fill the reservoir with hydraulic fluid of the recommended type and viscosity. Use a 10-micron reservoir filler filter. Ensure inlet line from reservoir to pump is filled.
6. Disconnect the pump from all control input signals.

   After start-up the oil level in the reservoir may drop due to filling of the system components. Check the level in the reservoir to maintain a full oil level throughout start-up.

   Warning

   Damage to hydraulic components may occur if you fail to maintain the oil supply.
7. Use a common method to disable the engine to prevent it from starting. Crank the starter for several seconds. Do not to exceed the engine manufacturer's recommendation. Wait 30 seconds and then crank the engine a second time as stated above. This operation helps remove air from the system lines. Refill the reservoir to recommended full oil level.
8. Check the pressure gauge at M3. When charge pressure begins to build, enable and start engine. Let the engine run for a minimum of 30 seconds at low idle to allow the air to work itself out of the system. Check for leaks at all line connections and listen for cavitation. Check for proper fluid level in reservoir.

   Caution

   Air entrapment in oil under high pressure may damage hydraulic components. Do not run at maximum pressure until system is free of air and fluid has been thoroughly filtered.
9. When the pump estabishes adequate charge pressure (as shown in model code), increase engine speed to normal operating rpm to further purge residual air from the system.
10. Shut off engine. Connect pump control signal. Start engine, checking to be certain pump remains in neutral. Run engine at normal operating speed and carefully check for forward and reverse control operation.
11. Continue to cycle between forward and reverse for at least five minutes to bleed all air and flush system contaminants out of loop.

    Normal charge pressure fluctuation may occur during forward and reverse operation.
12. Check that the reservoir is full. Remove charge pressure gauge. Re-intall charge pressure plug. The pump is now ready for operation.

Required tools and pressure measurements

Required tools

The service procedures described in this manual can be performed using common mechanic's hand tools. Special tools, if required, are shown. When testing system pressures, calibrate pressure gauges frequently to ensure accuracy. Use snubbers to protect gauges.

Port locations and gauge installation

The following tables and drawing show the port locations and gauge sizes needed.

Port information

Port identifier	Port size	Wrench size	Pressure obtained	Gauge size, bar [psi]
L1, L2	1-1/16 12 SAE	9/16 internal hex	Case drain	10 [150]
MA, MB	9/16 18 SAE	11/16 hex	System pressure	600 [9,000]
M3	9/16 18 UNF	11/16 hex	Charge pressure	50 [750]
M4, M5	9/16 18 SAE	11/16 hex	Servo pressure	50 [750]

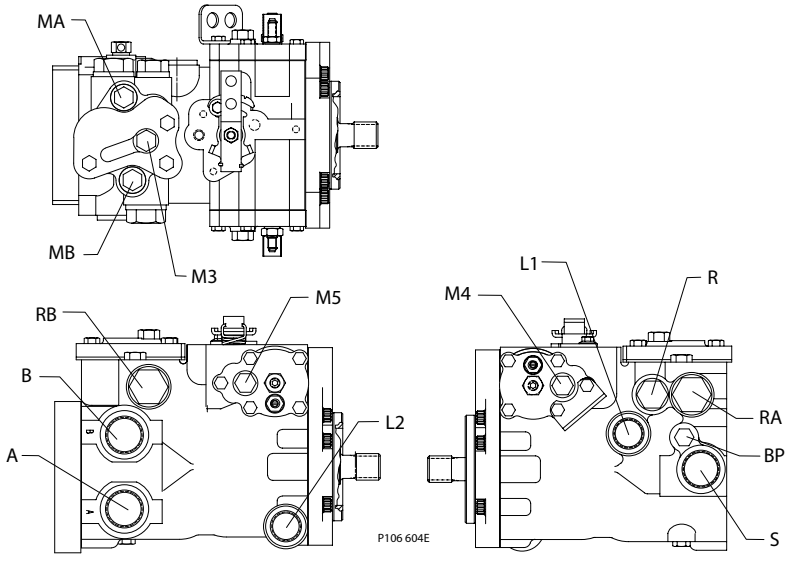
System valves

Port identifier	Relief	Port size	Wrench size
RA	A port pressure relief valve	1-5/16 12 UNF	1-1/4 hex
RB	B port pressure relief valve	1-5/16 12 UNF	1-1/4 hex
R	Charge pressure relief valve	3/4 16 UNF	7/8 hex
BP	Bypass valve	5/8 18 UNF	1 inch hex

System ports

Port identifier	Port size
A system pressure port	1-5/16 12 SAE
B system pressure port	1-5/16 12 SAE
S (charge pressure inlet)	1-5/16 12 SAE

Port locations



Troubleshooting

Overview

This section provides general steps to follow if undesirable system conditions occur. Follow these steps until you solve the problem. Some of the items are system specific. For areas this manual covers, we reference the section. Always observe the safety precautions in *Introduction* on page 5 and those related to your specific equipment.

Safety precautions

Caution

High inlet vacuum causes cavitation which can damage internal pump components. Ensure charge pump supply plumbing is adequate. Locating pump below the level of the reservoir, when possible, improves inlet conditions.

Caution

Contamination can damage internal components and void the manufacturer's warranty. Take precautions to ensure system cleanliness when removing and reinstalling system lines

System noise or vibration

Item	Description	Action
Reservoir oil level	Low oil level leads to cavitation.	Fill reservoir.
Aeration of the oil/pump inlet vacuum	Air in system decreases efficiency of units and controls. Excessive noise, foaming oil, and heat may indicate air in system.	Find location where air is entering into the system and repair leak. Check that inlet line is not restricted and is the proper size.
Cold oil	Cold oil may be too viscous for proper function: pump cavitates.	Allow the oil to warm up to it's normal operating temperature with engine at idle speed.
Pump inlet vacuum	High inlet vacuum causes noise/cavitation.	Check that inlet line is not restricted and is the proper size. Check filter and bypass valve.
Shaft couplings	A loose shaft coupling causes excessive noise.	Replace loose shaft coupling. Replace pump shaft.
Shaft alignment	Misaligned shafts creates noise.	Align shafts.
Charge/system relief valves	Unusual noise may indicate sticking valves, possible contamination.	Clean/replace valves and test pump. May be a normal condition.

System operating hot

Item	Description	Action
Oil level in reservoir	Insufficient hydraulic fluid will not meet the cooling demands of system.	Fill the reservoir to the proper level with clean hydraulic oil.
Heat exchanger (if equipped)	The heat exchanger is not sufficiently cooling the system.	Check the air flow and input air temperature for the heat exchanger. Clean, repair, or replace the heat exchanger as necessary.
Heat exchanger bypass valve	A partially activated heat exchanger bypass valve may result in heat generation within the system.	Verify that the bypass valve is fully closed and that the valve is seating properly. Repair or replace as necessary.
SCR (System Check / Relief) Valves	A partially activated SCR valve or SCR valves with relief settings too low may generate heat within the system.	Verify that the SCR valve is seating properly and is at the correct relief setting. Repair or replace it as necessary.
Oil filters	Clogged oil filters may result in an insufficient supply of cool oil to the system.	Inspect the oil filters and verify that they are still operable. Replace them if necessary.

Troubleshooting

Item	Description	Action
Machine load	Excessive loads or extreme duty cycles can result in the pump and/or motor operating at speeds and pressures beyond system design limitations.	Verify that the machine is operating within the parameters for which it was designed. If necessary, reduce the load on the machine.

System will not operate in one direction

Item	Description	Action
Input control signal (linkage, current, or pressure)	A faulty control signal is being received at the pump. (MDC - binding or broken linkage, EDC - faulty or inadequate electrical signal, HDC - blocked or incorrectly orificed control lines).	Verify that the input signal being received is correct and identical in both directions. Adjust, clean, repair, or replace the control module as necessary.
Displacement limiters (if equipped)	The displacement limiters may be improperly adjusted such that the servo piston is prevented from moving in one direction.	Verify that the displacement limiters are adjusted properly.
SCR (system check / relief) valves	The SCR valves are malfunctioning or improperly set.	Verify that the SCR valves are operating properly. Repair or replace them as necessary.
Pump control	A damaged or biased pump control may be sending a signal commanding the pump to stroke only in one direction.	Verify that the pump's control is functioning properly. Repair or replace it as necessary.
Servo pressure	The drain or supply path to one side of the servo piston may be blocked.	Verify that the servo supply and drain paths are unobstructed and that each orifice is of the correct size and free of debris. Clean or repair them as necessary.

System will not operate in either direction

Item	Description	Action
Oil level in reservoir	There is insufficient hydraulic fluid to supply the system loop.	Fill the reservoir to the proper level with clean hydraulic oil.
Displacement limiters	Displacement limiters may be improperly adjusted such that the servo piston is locked in place.	Verify that the displacement limiters are adjusted to the proper setting.
Input control signal (linkage, current, or pressure)	A faulty control signal being received at the pump. (MDC - binding or broken linkage, EDC - faulty or inadequate electrical signal, HDC - blocked or incorrectly orificed control lines)	Verify that the input signal being received is correct and identical in both directions. Adjust, clean, repair, or replace the input device as necessary.
Oil filters	Clogged oil filters may result in an insufficient supply of oil to the system.	Inspect the oil filters and verify that they are still serviceable. Replace them as necessary.
Bypass valve	A partially activated bypass valve (one or both) may result in a cross port leakage.	Verify that the bypass valves are closed and that the valves are seating properly. Clean, repair, or replace them as necessary.
Charge pressure (in neutral)	Charge pressure may be insufficient to recharge the system loop.	Inspect the charge pump for damage and verify that the charge pressure relief valve is at the proper setting. Repair or replace it as necessary.
Charge pressure (in stroke)	There is low charge pressure resulting from internal leakage within the system.	Repair or replace the component or components within the system causing the internal leakage.
Servo pressure	There is an insufficient pressure differential across the servo piston.	Check servo pressures to verify sufficient pressure delta. Verify that the servo supply and drain paths are unobstructed and that each orifice is of the correct size and free of debris. Clean, repair, or replace them as necessary.

Troubleshooting

Item	Description	Action
Charge pump	The charge pump is damaged or has been installed with the incorrect rotational orientation.	Verify that the charge pump is in good working order and that it is correctly installed. Repair or replace it as necessary.
SCR (system check / relief) valves	The SCR valves are malfunctioning or improperly set.	Verify that the SCR valves are operating and properly set. Repair or replace them as necessary.

Neutral difficult or impossible to find

Item	Description	Action
Input control signal (linkage, current, or pressure)	A faulty control signal is being received at the pump. (MDC - binding or broken linkage, EDC - faulty or inadequate electrical signal, HDC - blocked or incorrectly orificed control lines)	Verify that the input signal being received is correct and identical in both directions. Adjust, clean, repair, or replace control module as necessary.
System pressure	With no input signal to the control, a pressure delta may exist between the two sides of the working loop.	Readjust pump neutral setting. Refer to *Swashplate neutral adjustment* on page 21.
Servo pressure	With no input signal to the control, a pressure delta may exist across the servo piston.	Readjust the control neutral setting. Refer to *Manual Displacement Control Neutral-Return Bracket Adjustment* on page 22 and *Electric Displacement Control/Hydraulic Displacement Control Neutral Adjustment* on page 23
PCP pressure (EDCs only)	With no input signal to the control, a pressure difference may exist across the control spool.	Replace the EDC.

System response is sluggish

Item	Description	Action
Reservoir oil level	There is an insufficient amount of hydraulic fluid, resulting in an inadequate supply for the system loop.	Fill the reservoir to the proper level with clean hydraulic fluid.
Input control signal (linkage, current, or pressure)	A faulty control signal is being received at the pump. (MDC - binding or broken linkage; EDC - faulty or inadequate electrical signal; HDC - blocked or incorrectly orificed control lines)	Verify that the input signal being received is correct and identical in both directions.
Pump control	A damaged pump control or control spool will not correctly transmit the control input signal to the pump.	Verify that the pump's control is operating properly and that the control spool is not damaged or worn and moves freely within its bore. Clean, repair, or replace it as necessary.
Bypass valve	A partially activated bypass valve causes cross port leakage.	Verify that the bypass valve is closed and that the valve is seating properly. Clean, repair, or replace it as necessary.
SCR (system check / relief) valves	One or both of the SCR valves may be binding within their bores.	Verify that the SCR valves operate freely. Repair or replace them as necessary.
Charge pressure (in neutral)	There is low charge pressure resulting from a damaged charge pump or low charge pressure relief valve setting.	Inspect the charge pump for damage and verify the charge pressure relief valve setting. Repair or replace as necessary.
Charge pressure (in stroke)	There is low charge pressure resulting from internal leakage within the system.	Repair or replace the component or components within the system causing the internal leakage.
Servo pressure	There is insufficient pressure differential across the servo piston.	Check servo pressures at port M4 and M5 to verify sufficient pressure delta. Verify that the servo supply and drain paths are unobstructed and that each

Troubleshooting

Item	Description	Action
		orifice is of the correct size and free of debris. Clean, repair, or replace as necessary.
Charge pump	The charge pump has been damaged or installed with the incorrect rotational orientation.	Verify that the charge pump is in good working order and that it is correctly installed. Repair or replace it as necessary.

Electrical troubleshooting

Item	Description	Action
Control operates pump in one direction only	Control coil had failed (EDC).	Measure resistance at coil pins. Resistance should be 14.20 ohms (24V) or 3.66 ohms (12V) at 20°C [70°F]. Replace coil.
No pump function	No power to controller.	Restore power to controller.
Erratic pump function	Electrical connection to pump is bad.	Disconnect connection, check wires, reconnect wires.
Filter bypass indicator switch	Filter switch may be bad.	Check/replace filter switch. Add gauge to filter bypass port to verify proper fluid flow and verify switch operation by measuring resistance. open resistance=>510 ohms, closed resistance<=122 ohms.

Adjustments

Standard procedures, inspections, and adjustments

Before working on the pump, clean all dirt and grime from the outside of the pump and surrounding area.

Caution

Contamination can damage internal components and void the manufacturer's warranty. Take precautions to ensure system cleanliness when removing and reinstalling system lines.

1. If removing the pump, tag each hydraulic line. If you disconnect hydraulic lines, plug each open port to ensure that dirt and contamination do not get into the pump.
2. Inpect the hydraulic fluid for signs of system contamination, oil discoloration, foam in the oil, sludge, or small metal particles.
3. If there are signs of contamination in the hydraulic fluid, replace all filters and drain and clean the hydraulic system. Fill with the correct hydraulic fluid.
4. Flush the lines before replacing the hydraulic fluid.
5. Before re-installing the pump, test for leaks.

Warranty

Performing installation, maintenance, and minor repairs according to the procedures in this manual will not affect your warranty. Major repairs requiring the removal of a unit's front flange voids the warranty unless done by a Danfoss Global Service Partner.

Pump adjustment

This section offers instruction on adjustment of pump components. Read through the entire topic before beginning a service activity. Refer to *Port locations and gauge installation* on page 12, for location of gauge ports and suggested gauge size.

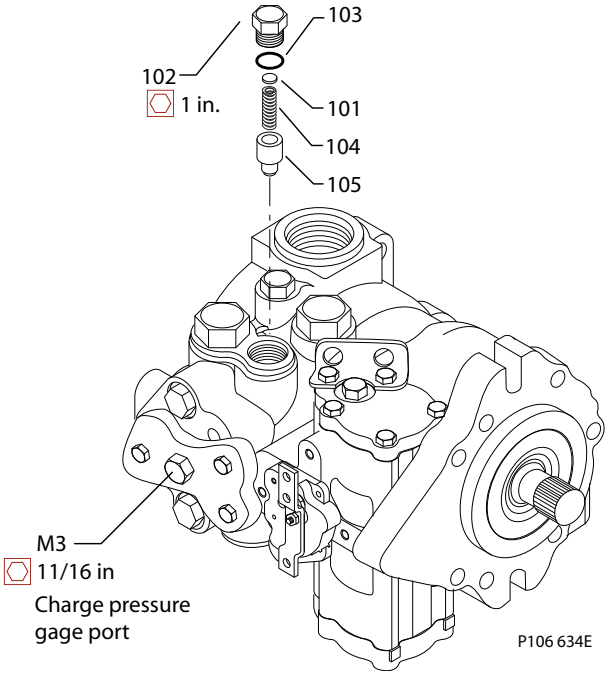
Charge pressure relief valve

This procedure explains how to check and adjust the charge pressure relief valve.

1. Install a 50 bar [1000 psi] pressure gauge in charge pressure gauge port M3. Install a 10 bar [100 psi] gauge in one of the case pressure ports L1 or L2. Operate the system with the pump in neutral (zero displacement) when measuring charge pressure.
2. To adjust charge pressure, shut down system.
3. Using a 1 inch hex wrench, remove charge pressure relief plug (102). Add or remove shims (101) in relief valve. Adding shims increases charge pressure, while removing shims decreases charge pressure.
4. Lubricate and install new O-ring (103).
5. Using a 1 inch hex wrench, reinstall plug. Torque to 108 N•m [80 lbf•ft].
6. Operate pump in neutral to verify proper charge setting. Charge pressure is referenced to case pressure. Subtract case pressure (L1/L2) from charge pressure (M3) to compute actual setting. Repeat steps 1-5 if necessary.
7. Remove gages and replace plugs (M3, L1/L2). Using an 11/16 in. hex wrench, torque plug (M3) to 37 N•m [27 lbf•ft]. Using a 9/16 in. internal hex wrench, torque plug (L1/L2) to 115 N•m [85 lbf•ft].

Adjustments

Charge pressure adjustment



Engaging the bypass function

Test bypass function with pump installed on machine. The bypass function is engaged by unscrewing the bypass valve. Do not open the bypass valve when machine is operating.

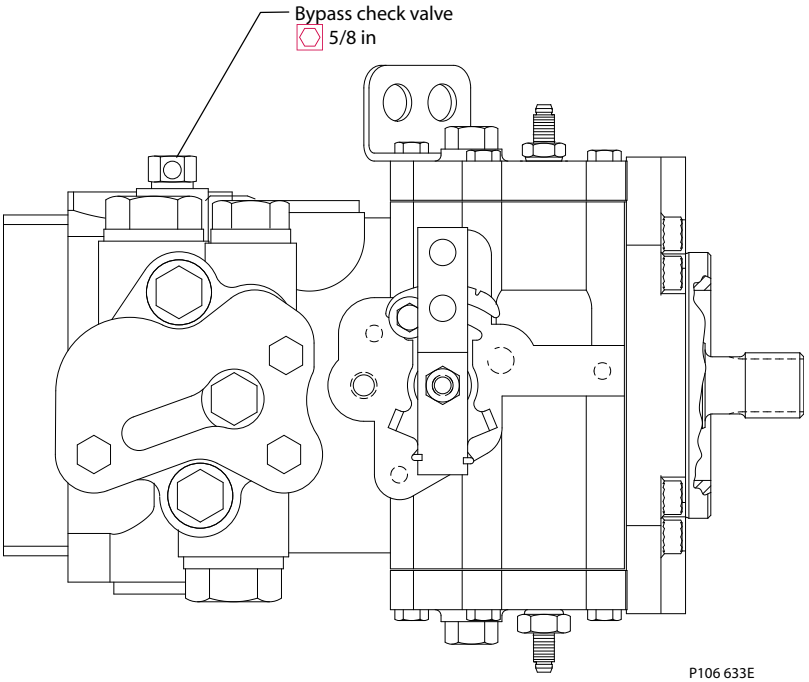
1. To engage the bypass function, use a 5/8 in. hex wrench to unthread the bypass valve.Rotate the bypass valve approximately three turns counterclockwise. Do not rotate more than 3 revolutions: additional rotation permits external leakage.
2. To close the bypass valve, rotate the bypass valve clockwise until seated. Torque to 20 N•m [15 lbf•ft].
3. Vehicle/machine should move with bypass valve open. Close valve for normal operation.

Caution

Bypass valve is not a tow-valve. Damage to pump and motor is possible when operating without charge pressure. Limit speed of movement to 20% of the vehicle/machine's maximum for no longer than 3 minutes.

Adjustments

Using the bypass function



System check/relief (SCR) valves

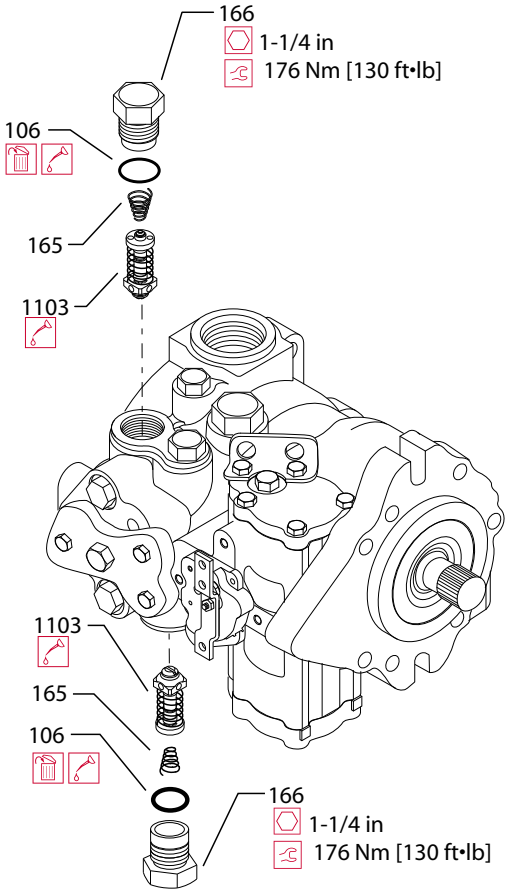
The SCR valve is a high pressure relief valve and a system check valve in combination. Whenever an SCR valve is replaced or opened, opperate the pump in its full range of functions to ensure proper machine operation. The SCR valves are pre-set at the factory, no adjustment is possible. Pressure code is marked on the valve. Refer to the model code for pressure designation. If you suspect SCR malfunction, replace valve and test operation of pump.

This procedure explains how to replace the SCR valves.

1. Shut down the system.
2. Using a 1-1/4 in. hex wrench, remove relief valve plug (166).
3. Remove spring (165) and relief valve (1103) from pump housing.
4. Insert new relief valve and spring into pump housing.
5. Lubricate and install new O-ring (106).
6. Using a 1-1/4 in. hex wrench, install relief valve plug. Torque to 176 N•m [130 lbf•ft].

Adjustments

Installing the SCRs



P106 635E

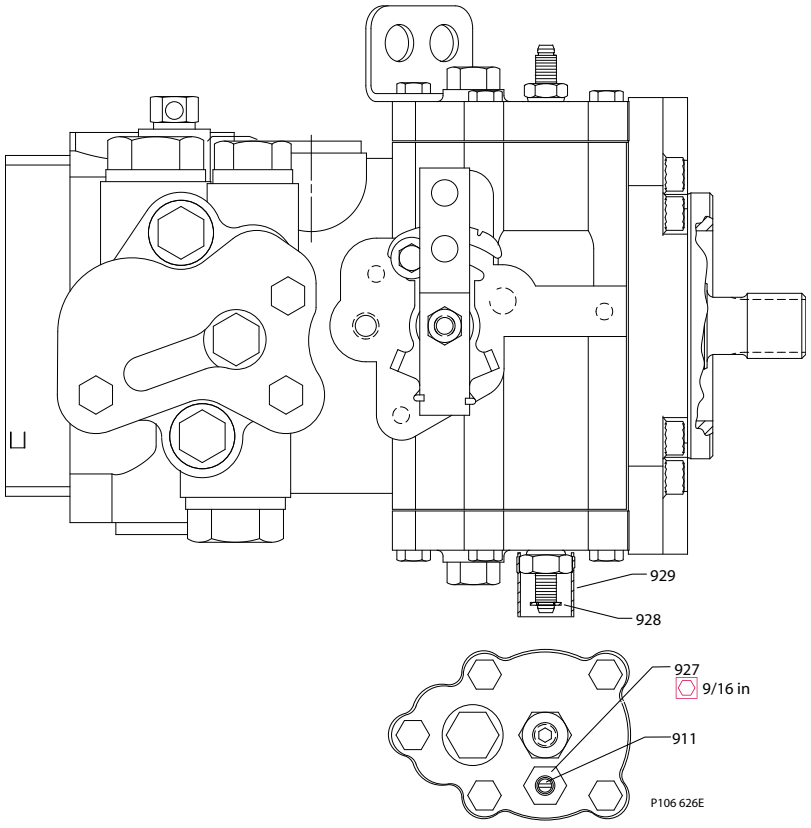
Displacement limiter adjustment

Pump may have a displacement limiter on each side of the servo. Each limiter may be adjusted to a different setting.

1. Remove snap ring (928) and sleeve (929).
2. Using a flat screw driver to hold the displacement limiter, loosen the locking nut (927) with a 9/16 hex wrench.
3. Rotate the displacement limiter (911) to adjust maximum displacement. Rotating the adjusting screw clockwise decreases the maximum displacement of the pump while rotating the adjusting screw counterclockwise increases the maximum displacement. The displacement changes approximately 4 cm^3 per revolution.
4. After establishing the desired maximum displacement setting, hold displacement limiter in place using a flat screw driver and tighten the locking nut with a 9/16 in. hex wrench. Torque to 12 N•m [9 lbf•ft]. Repeat if necessary to adjust maximum displacement in other direction.
5. After adjustment, verify proper maximum vehicle/machine speed. Readjust if necessary.

Adjustments

Displacement limiter adjustment



Swashplate neutral adjustment

With the pump properly plumbed, primed, and mounted on a vehicle or test stand, use this procedure to adjust mechanical neutral. If pump is on a vehicle, securely block the wheels to prevent movement.

Measured data

- System pressure at MA
- System pressure at MB
- Pressure differential between MA and MB (optional)

Pump Setup

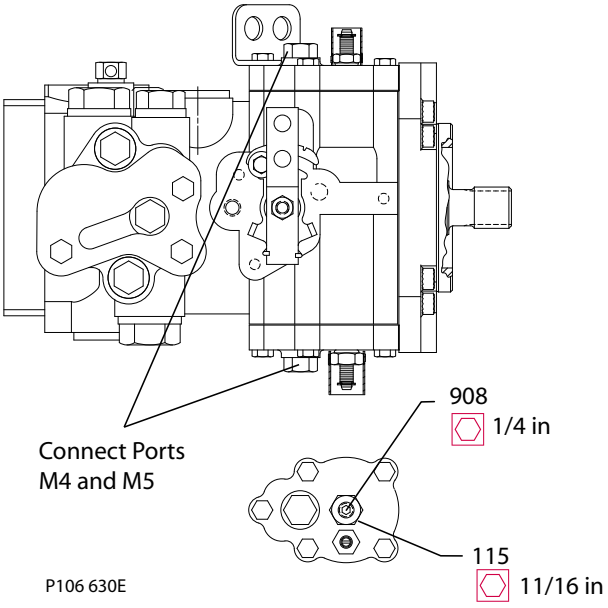
1. Attach 600 bar [10,000 psi] gauge to system pressure gage ports MA and MB.
2. Using a hydraulic line and fittings, shunt the servo piston by connecting servo pressure ports (M4 and M5).

   Connecting servo ports M4 and M5 defeats the affect of any control pressure on the servo piston.
3. Run prime mover at normal operating speed.
4. Use a 1/4 hex wrench to hold adjusting screw (908) in place and a 9/16 hex wrench to loosen servo lock nut (115).
5. Turn neutral adjustment screw (908) until one system pressure gage begins to show an increase in pressure. Note position of screw. Turn the neutral adjustment screw (908) in the opposite direction until the other system pressure gage begins to show an increase in pressure. Note position of screw. Turn the neutral adjustment screw half way between the two postitions.

Adjustments

6. Use a 1/4 hex wrench to hold the servo adjustment screw in place, and a 9/16 hex wrench to tighten servo lock nut (115). Torque to 37 N•m [27 lbf•ft].
7. Shut down prime mover and remove previously installed gauges and fittings. Plug ports MA, MB, M4, and M5.

Servo neutral adjustment



Manual Displacement Control Neutral-Return Bracket Adjustment

With the pump properly plumbed, primed, and mounted on a vehicle or test stand, use the following procedure to adjust the pump displacement control to neutral position. If pump is on a vehicle, securely block the wheels to prevent movement. Check swashplate mechanical neutral adjustment before adjusting control bracket. Refer to previous topic *Swashplate neutral adjustment* on page 21 for instructions. If swashplate neutral is properly adjusted and system is not in neutral, adjust MDC bracket as described below.

Measured data

- Servo pressure at M4
- Servo pressure at M5
- Pressure differential between M4 and M5 (optional)

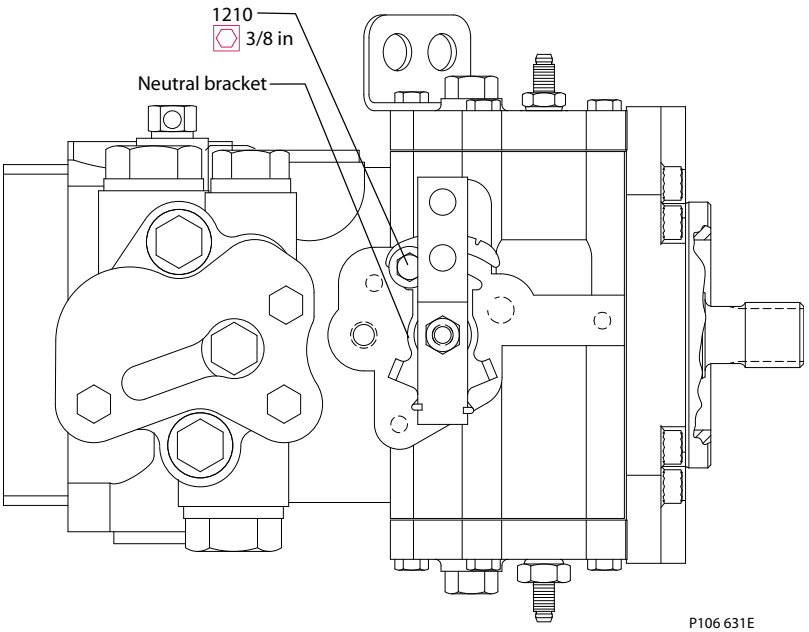
Procedure

1. Attach 20 bar [300 psi] gauge to each servo gage port M4 and M5. Run prime mover at normal operating speed.
2. Using a 3/8 in. hex wrench, loosen screw (1210) allowing the neutral bracket to move, but not freely.
3. Start prime mover and slowly accelerate to normal operating rpm.
4. Using your hand, press neutral bracket towards the pump housing, and rotate it until one of the servo pressure gages indicates an increase in pressure. Note position of bracket. Rotate neutral bracket in opposite direction until the other servo pressure gage indicates an increase in pressure. Note position of bracket. Rotate neutral bracket half way between the two positions.
5. Holding the neutral adjustment bracket in place, use a 3/8 in. hex wrench to tighten screw (1210). Torque to 14 N•m [10 lbf•ft].

Adjustments

6. Shut down prime mover and remove previously installed gauges. Plug ports M4, M5. Torque to 37 N•m [27 lbf•ft]

Manual displacement control bracket adjustment



Electric Displacement Control/Hydraulic Displacement Control Neutral Adjustment

With the pump properly plumbed, primed, and mounted on a vehicle or test stand, use this procedure to adjust the pump displacement control to neutral position. If pump is on a vehicle, block the wheels to prevent movement.

Measured data

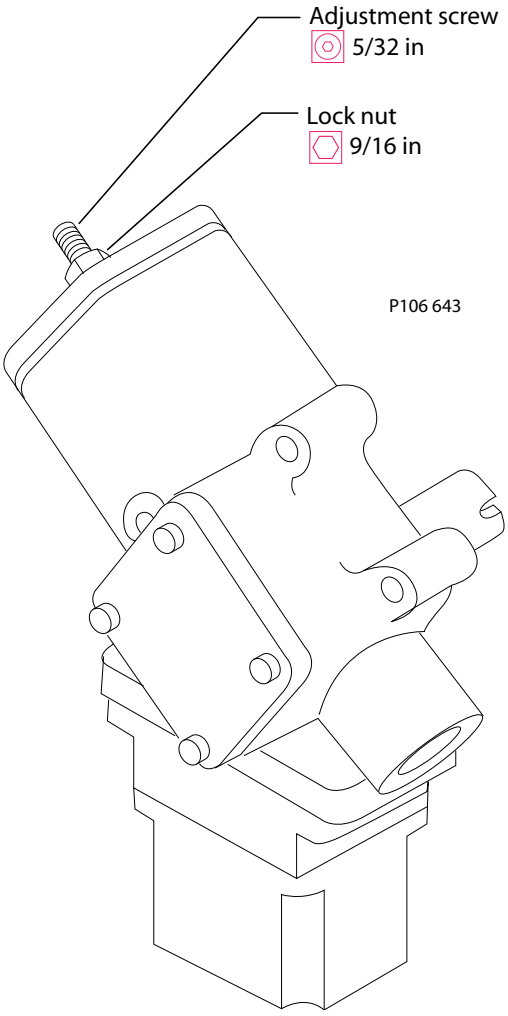
- Servo pressure at M4
- Servo pressure at M5
- Pressure differential between M4 and M5 (optional)

Procedure

1. Attach 20 bar [300 psi] gauge to each servo gage port.
2. Use a 5/32in. internal hex wrench to hold the adjusting screw in place and a 1/2 hex wrench, loosen locknut.
3. Start prime mover and slowly accelerate to normal opperating rpm.
4. Rotate adjustment screw until one of the servo pressure gages indicates an increase in pressure. Note position of screw. Rotate adjustment screw in opposite direction until the other servo pressure gage indicates an increase in pressure. Note position of screw. Rotate adjustment screw halfway between the two positions.
5. While holding the neutral adjustment screw in place, tighten locknut. Torque to 3 N•m [27 lbf•in].
6. Stop prime mover and remove previously installed gauges. Plug ports M4, M5. Torque to 37 N•m [27 lbf•ft]

Adjustments

EDC / HDC control adjustment



Minor repair

Standard procedures, removing the pump

Before working on the pump, clean all dirt and grime from the outside.

If the pump has an auxiliary pump attached, remove both pumps as a single unit.Tag all hydraulic lines as they are disconnected and plug all open ports to ensure that dirt and contamination do not get into the pump.

Caution

Contamination can damage internal components and void the manufacturer's warranty. Take precautions to ensure system cleanliness when removing and reinstalling system lines.

Removal

1. With the prime mover off, thoroughly clean all dirt and grime from the outside of the pump.
2. Tag and disconnect each hydraulic line connected to the pump. As hydraulic lines are disconnected, plug each open port, to ensure that dirt and contamination do not get into the pump.
3. Remove the pump and its auxiliary pump (if applicable) as a single unit.

Caution

Be careful not to damage solenoids and electrical connections when using straps or chains to remove pump from machine.

Inspection

1. Ensure the work surface and surrounding area are clean and free of contaminants such as dirt and grime.
2. Inspect the hydraulic fluid for signs of system contamination, oil discoloration, foam in the oil, sludge, or small metal particles.

Reassembly

1. Before replacing the pump on the machine, replace all filters and drain the hydraulic system. Fill the system with the correct, filtered, hydraulic fluid.
2. Flush the lines before replacing the hydraulic fluid.

   For repair part information, see *Danfoss publication Series 40 M46 Variable Pump Parts Manual* **BLN-2-41701** for your model.

Displacement limiter

Removal

Only remove displacement limiter (911) if replacement is necessary. Mark the location of displacement adjustment and neutral adjustment screws before disassembly. This saves time during re-assembly.

1. Remove snap ring (928) and sleeve (929). Use a 1/4 in. hex wrench to hold neutral adjustment screw in place. Use a 9/16 in. hex wrench to remove hex nut (115).
2. Use a flat screw driver to hold displacement limiter (911) in place. Use a 9/16 in. hex wrench to remove lock nut (927).
3. Using a 3/8 in. hex wrench, remove five bolts (921) from servo cover (902).
4. Unscrew servo cover (902) to remove it from neutral adjustment screw. Remove and discard gasket (936).
5. Turn displacement limiter (911) out of servo cover (902).

Minor repair

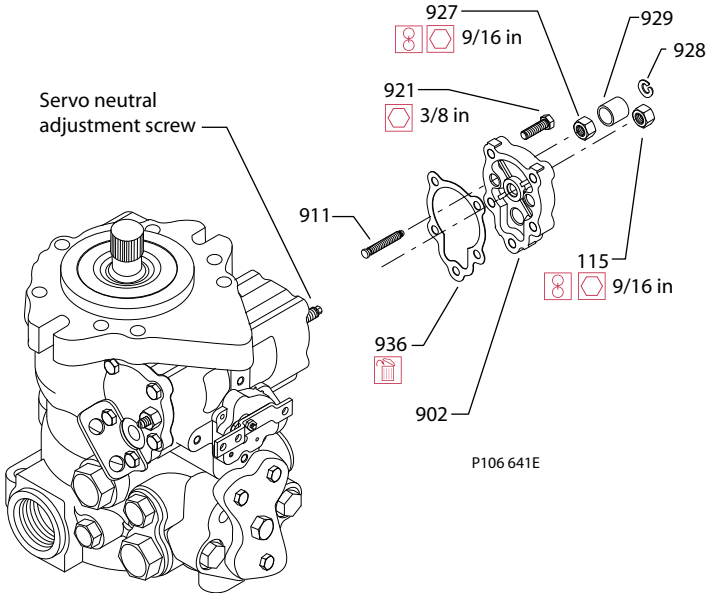
Inspection

Inspect all parts for damage. Inspect the mating surfaces of the servo cover (902) and pump housing for scratches, grooves, and other damage. Inspect threads of screws and nuts for damage. Replace any damaged parts.

Reassembly

1. Turn displacement limiter (911) into servo cover (902). Install new gasket (936) and turn servo cover (902) onto neutral adjustment screw.
2. Using a 3/8 in. hex wrench, install five bolts (921). Torque to 15 N•m [11 lbf•ft].
3. Adjust displacement limiter to position originally noted during disassembly. Use a flat screw driver to hold displacement limiter. Use a 9/16 in. hex wrench to install seal nut (927) onto displacement limiter (911). Torque to 12 N•m [9 lbf•ft].
4. Set neutral adjustment screw at the position noted during disassembly. Use a 1/4 in. hex wrench to hold neutral adjustment screw and a 9/16 in. hex wrench to install hex nut (115). Torque to 37 N•m [27 lbf•ft]. Install sleeve (929) and snap ring (928).

Displacement limiter removal/installation



Pressure filtration adapter

Removal

1. Using an 11/16 in. hex wrench, remove plug (810). Remove and discard O-ring (810A).
2. Using a 1/2 in. hex wrench, remove screws (806).
3. Remove pressure filtration cover (801). Remove and discard seal adapter (805).

Inspection

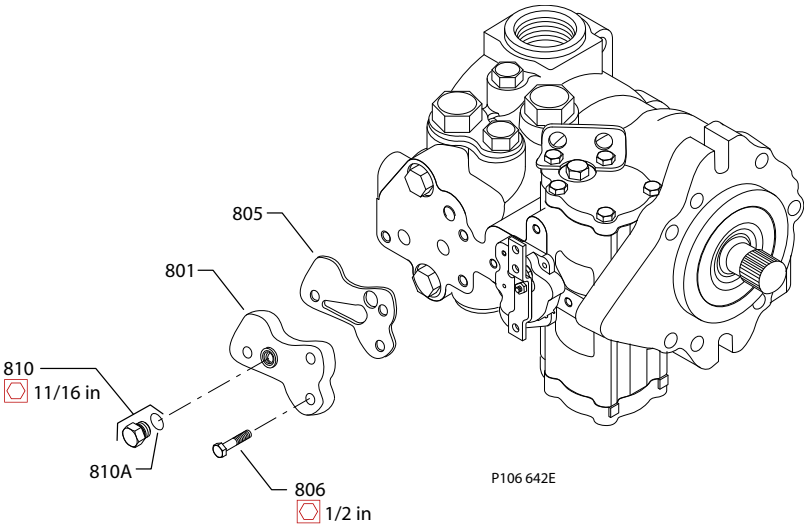
Inspect the machined surface on the control. If any nicks or scratches are found, replace the damaged component.

Minor repair

Reassembly

1. Install new seal adapter (805) and filtration cover (801).
2. Using a 1/2 hex wrench, install three screws (806). Torque to 30 N•m [22 lbf•ft].
3. Lubricate and install O-ring (810A) onto plug (810). Using an 11/16 in. hex wrench, install plug (810). Torque to 37 N•m [27 lbf•ft].

Pressure filtration adapter removal/installation



Charge pump

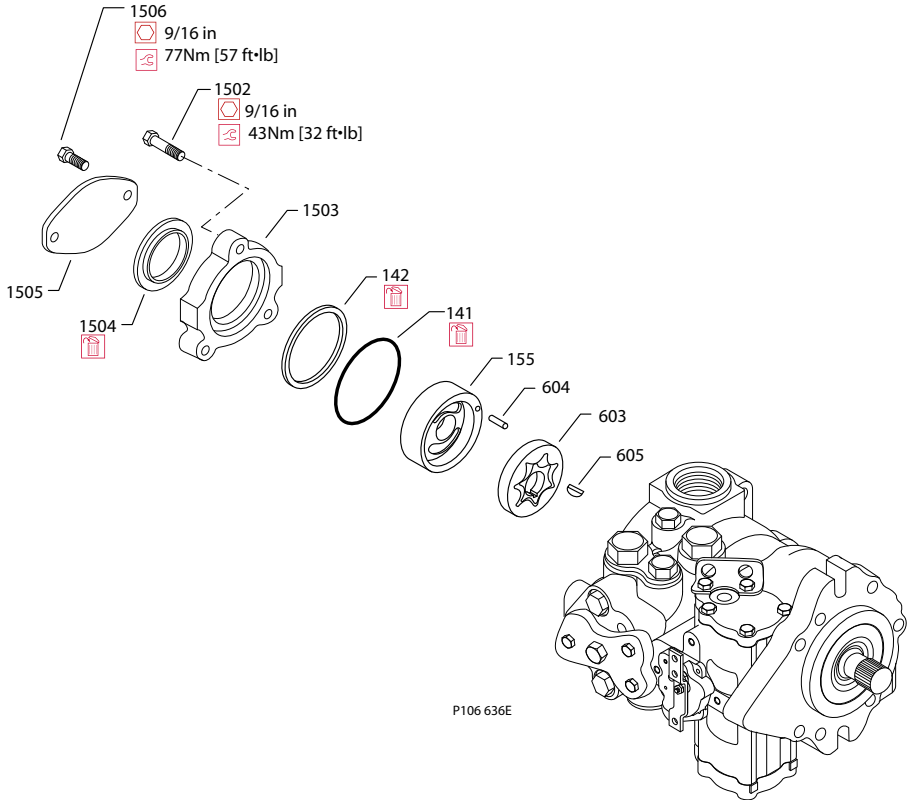
Removal

If a gear pump is attached to the auxiliary pad, remove the gear pump and O-ring or gasket.

1. Using a 9/16 in. hex wrench, remove screws (1506) and cover plate (1505). Remove and discard seal (1504).
2. Using a 9/16 in. hex wrench, remove screws (1502). Remove auxiliary pad (1503).
3. Remove and discard O-ring (141) and load ring (142).
4. Remove gerotor cover (155) and gerotor (603).
5. Remove pin (604) and key (605).

Minor repair

Charge pump removal/installation



Inspection

Inspect the gerotor (603) and gerotor cover (155) for wear, scratches or pitting. If any component shows signs of wear, scratching, or pitting, relpace all components. Inspect pin (604) and key (605) for damage, and replace parts if necessary. Replace O-ring (141), load ring (142), and seal (1504) whenever charge pump is disassembled.

Reassembly

Charge pump parts are available as a complete set

1. Install key (605). Lubricate and install gerotor assembly (603).
2. Install pin (604) and gerotor cover (155).
3. Lubricate and install new O-ring (141) and load ring (142). Install auxiliary pad (1503).
4. Using a 9/16 in. hex wrench, install screws (1502). Torque to 43 N•m [32 lb•ft].
5. Lubricate and press seal (1504) onto auxiliary pad (1503).

   If a gear pump is a ttached to the auxiliary pad, install a new O-ring or gasket and gear pump
6. Install cover plate (1505). Using a 9/16 in. hex wrench, install capscrews (1506). Torque to 77 N•m [57 lbf•ft].

   If a gear pump is attached, seal (1504), cover (1505), and bolts (1506) are not used. Replace O-ring or gasket between gear pump and M46 pump.

Minor repair

Shaft seal, roller bearing and shaft replacement

The shaft assembly is serviceable without removing the front cover of the pump, but the charge pump must be removed first. Orient the pump on the work surface so the shaft is pointing up with the charge pump (603) and key (605) removed from shaft. See *Charge pump* on page 27

Removal

1. Using a snap-ring pliers, remove snap-ring (132) from pump cover. Remove and discard seal (301). Remove second snap-ring (132).
2. Remove shaft assembly from pump cover.

Caution

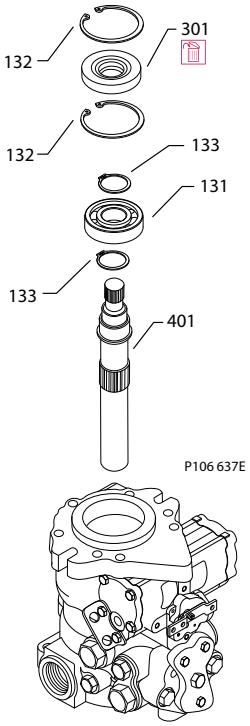
Do not damage the housing bore, shaft, or bearing when removing the shaft and shaft seal.

3. Using a snap ring pliers, remove both snap-rings (133). Press bearing (131) off of shaft.

Caution

Do not rotate or move pump after removing shaft. Internal components may be dislodged making shaft replacement impossible without complete disassembly.

Shaft assembly



Inspection

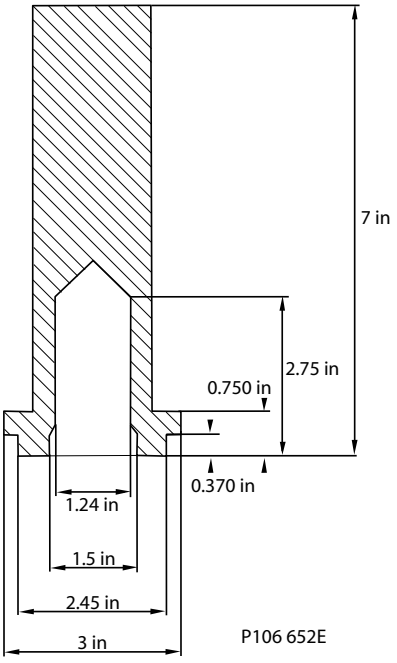
Inspect the shaft and bearing for wear, scratching and pits. If wear, scratching or pitting is found, replace the shaft and bearing. Rotate bearing while feeling for roughness. Replace bearing if it doesn't spin freely.

Minor repair

Reassembly

1. Using a snap ring pliers, install snap-ring (133). Lubricate and press bearing (131) onto shaft. Install second snap-ring (133).
2. Install shaft and bearing assembly into front cover. Rotate shaft to align with block-splines. Ensure bearing is installed deep enough to clear snapring groove.
3. Using a snap ring pliers, install snapring (132).
4. Cover shaft splines with an installation sleeve to protect lipseal during installation. Lubricate and press new seal (301) into pump cover.
5. Install second snap-ring (132). Remove installation sleeve.

Shaft seal installation tool



SCR valves

The SCR valves are factory set and are not field adjustable.

Removal

1. Using a 1-1/4 in. hex wrench, remove relief valve plug (166). Remove and discard Oring (106).
2. Remove spring (165) and relief valve (1103) from pump housing.

Inspection

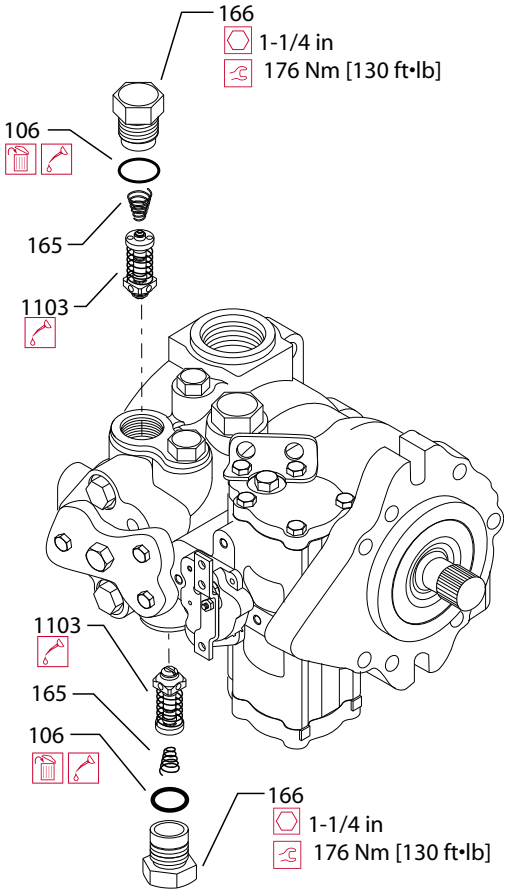
Inspect the sealing surfaces of the pump for nicks or scratches. Inspect the relief valve (1103) sealing surface for nicks or scratches. If the relief valve (1103) is damaged, replace it.

Reassembly

1. Lubricate and insert relief valve (1103) and spring (165) into pump housing.
2. Lubricate and install new O-ring (106) onto plug (166). Using a 1-1/4 in. hex wrench install relief valve plug (166). Torque to 176 N•m [130 lbf•ft].

Minor repair

SCR valves



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Charge pressure relief valve

Replace the charge pressure relief valve components if they are damaged or if you suspect failure. See *Charge pressure relief valve* on page 17, for adjustment instructions.

Removal

1. Using a 1 inch hex wrench, remove charge pressure relief plug (102). Remove and discard O-ring (103).
2. Remove shims (101), spring (104), and charge pressure relief valve (105).

Inspection

Inspect the sealing surfaces of the pump for nicks or scratches. Inspect the relief valve (105) sealing surface for nicks or scratches. If the relief valve (105) is damaged, replace it.

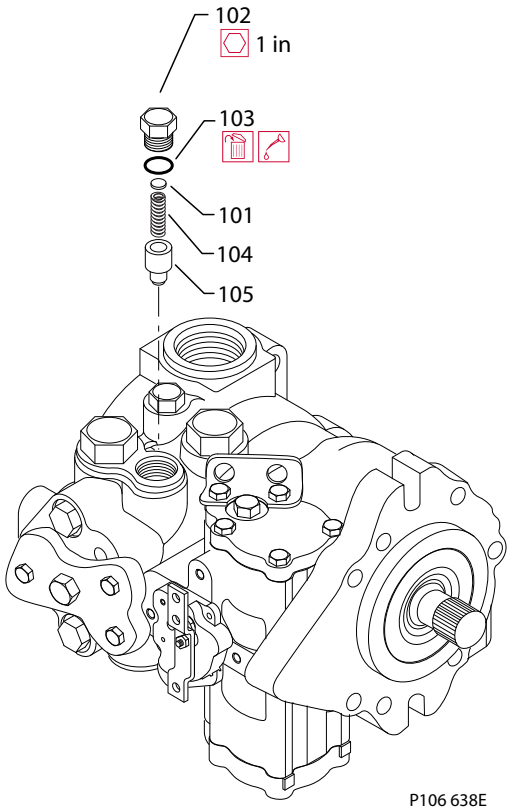
Reassembly

1. Install charge pressure relief valve, spring, and shims.
2. Lubricate and install O-ring onto plug. Using a 1 in. hex wrench, install plug. Torque to 108 N•m [80 lbf•ft].

Minor repair

3. Operate pump at full range of controls to ensure proper machine operation.

Charge pressure relief valve



Bypass valve

Removal

1. Using a 5/8 in. hex wrench, remove bypass valve (1001).
2. Remove and discard O-ring (1003) and backup ring (1002).

Inspection

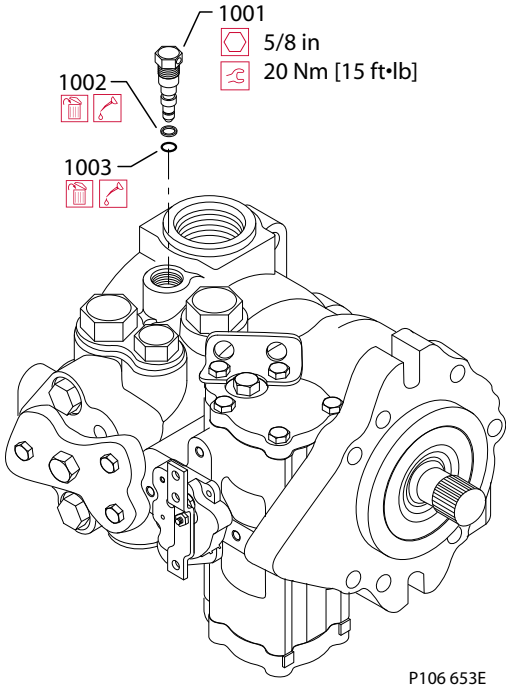
Inspect the sealing surfaces of the pump for nicks or scratches. Inspect the bypass valve (1001) sealing surface for nicks or scratches. Replace any damaged parts.

Reassembly

1. Lubricate and install new O-ring (1003) and backup ring (1002) onto bypass valve (1001).
2. Using a 5/8 in. hex wrench, install bypass valve (1001). Torque to 20 N•m [15 lbf•ft].
3. Operate pump at full range of controls to ensure proper machine operation.

Minor repair

Bypass valve



Manual displacement control

Removal

1. Using a 3/8 in. hex wrench, remove screw (1210). Remove manual control spool assembly from pump housing.
2. Using a 1/2 in. hex wrench, remove lock nut (1213). Remove lock washer (1235), handle (1215), neutral return bracket (1216), and spring (1214) from spool (1207).

   Mark the location of neutral return bracket (1216) before disassembly.
3. Remove and discard backup ring (1209) and O-ring (303) from spool.
4. Remove sleeve (1402). Remove and discard backup ring (1208) and O-ring (302).

Inspection

Inspect all parts of control assembly. Replace any damaged parts. Inspect spool and sleeve for grooves, scratches, and other damage. If spools are damaged, replace them. Inspect sleeve bore in housing for damage.

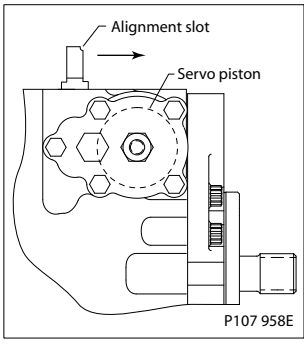
Reassembly

1. Lubricate and install O-ring (302) and backup ring (1208) onto sleeve (1402). Lubricate and install sleeve (1402) into motor housing.

   When installing sleeve (1402), ensure that sleeve groove engages spring pin on swashplate.
2. Lubricate and install O-ring (303) and backup ring (1209) onto spool (1207).

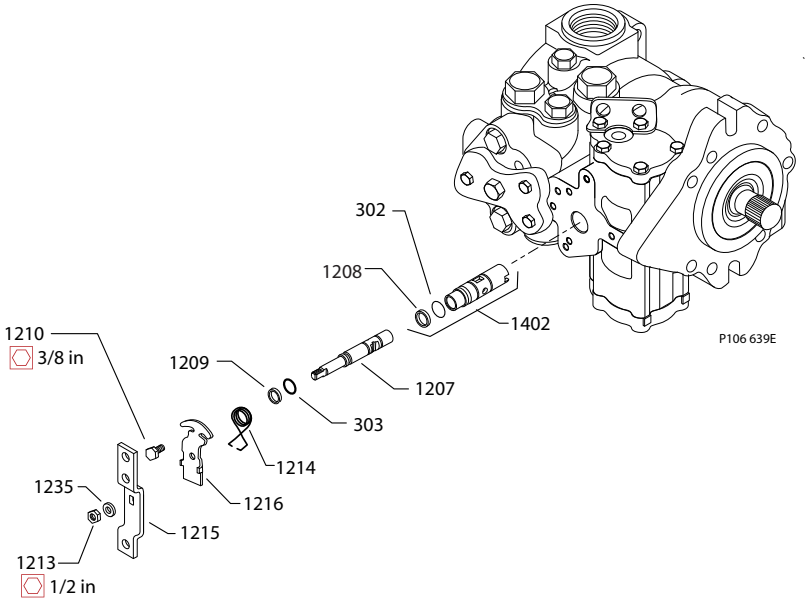
   Install control spool (1207) with alignment slot facing servo piston.

Minor repair



3. Install neutral return spring (1214), neutral return bracket (1216), handle (1215), and washer (1235) onto spool (1207).
4. Using a 1/2 in. hex wrench, install lock nut (1213). Torque to 15 N•m [11 lbf•ft].
5. Lubricate and install spool (1207) into sleeve (1402).
6. Using a 3/8 in. hex wrench, install screw (1210). Torque to 14 N•m [10 lbf•ft]. See *Manual Displacement Control Neutral-Return Bracket Adjustment* on page 22, for adjustment procedure.

Manual displacement control



Electronic displacement control/hydraulic displacement control

Removal

If you suspect control of failure, replace control and test pump for proper operation. When installing control, ensure that sleeve groove engages spring pin on swashplate.

1. Using a 3/16 in. internal hex wrench, remove screws (1203 and 1204) or (1224). If you have a three position controll, remove screws (1226) using a 4 mm internal hex wrench.
2. Remove control housing (1201) or manifold (1225). Remove and discard O-rings (1220 and 304) or (1227, 1228, and 1223A).

Minor repair

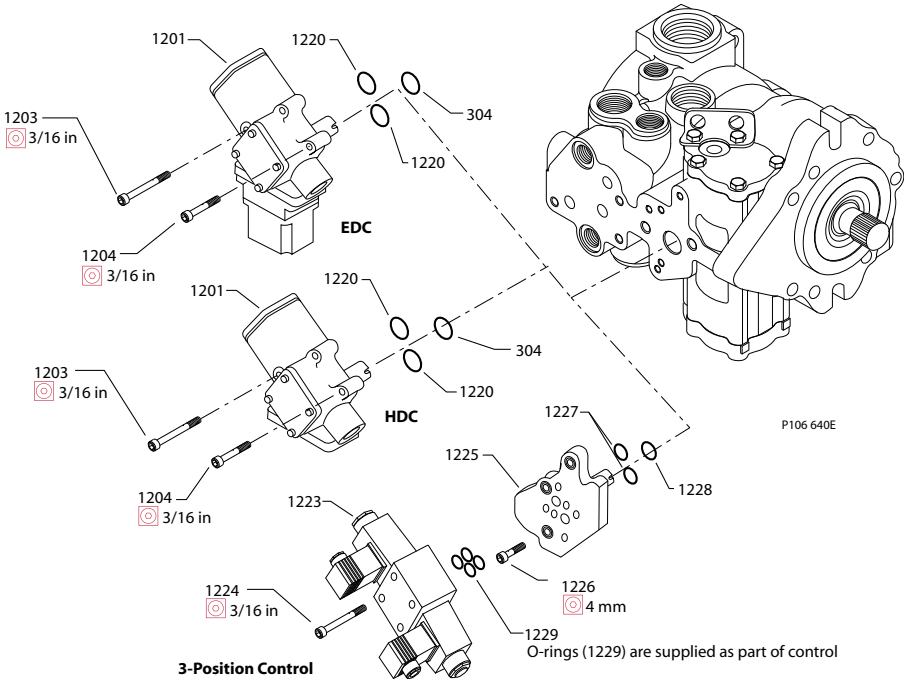
Inspection

Inspect control spool for scratches, grooves, and other damage. If spool is damaged, or you suspect control malfunction, replace entire control unit. Inspect sleeve bore in housing for damage.

Reassembly

1. Lubricate and install O-rings (1220 and 304) onto control housing (1201) or for a three position control, lubricate and install O-rings(1227 and 1228) onto manifold (1225) and O-rings (1229) onto control housing (1223). Install control housing (1201) or manifold (1225) onto pump housing, align sleeve groove with spring pin on swashplate.
2. If you have a three position control, use a 4 mm internal hex wrench to install screws (1226). Torque screws to 14 N•m [10 lbf•ft]. Install three posion control housing (1223). Using a 3/16 in. internal hex wrench, install screws (1203 and 1204) or (1224). Torque to 14 N•m [10 lbf•ft].

EDC / HDC repair



MDC orifice repair

Removal

Using a 3/16 in. internal hex wrench, remove pipe plug (1219). Using a 1/8 in. internal hex wrench, remove filter or orifice plug (1401).

Inspection

Clean orifice.Replace if necessary.

Reassembly

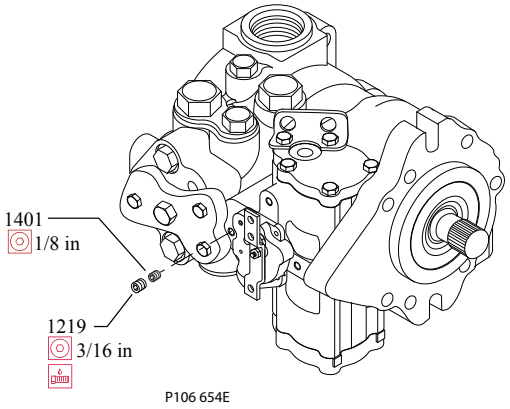
1. Using a 1/8 in. internal hex wrench, install filter or orifice plug (1401). Torque to 3 N•m [2 lbf•ft].

Minor repair

2. Using a 3/16 in. internal hex wrench, install pipe plug (1219). Torque to 22 N•m [16 lbf•ft].

Install Pipe plug (1219) with thread lock. Apply a few drops before installation.

MDC orifice repair



EDC/HDC orifice repair

Removal

1. Remove servo covers. See *Displacement limiter* on page 25, for servo cover removal and installation instructions.
2. Using a 7/32 in. internal hex wrench, remove orifice plugs (1403 and 1404).

Inspection

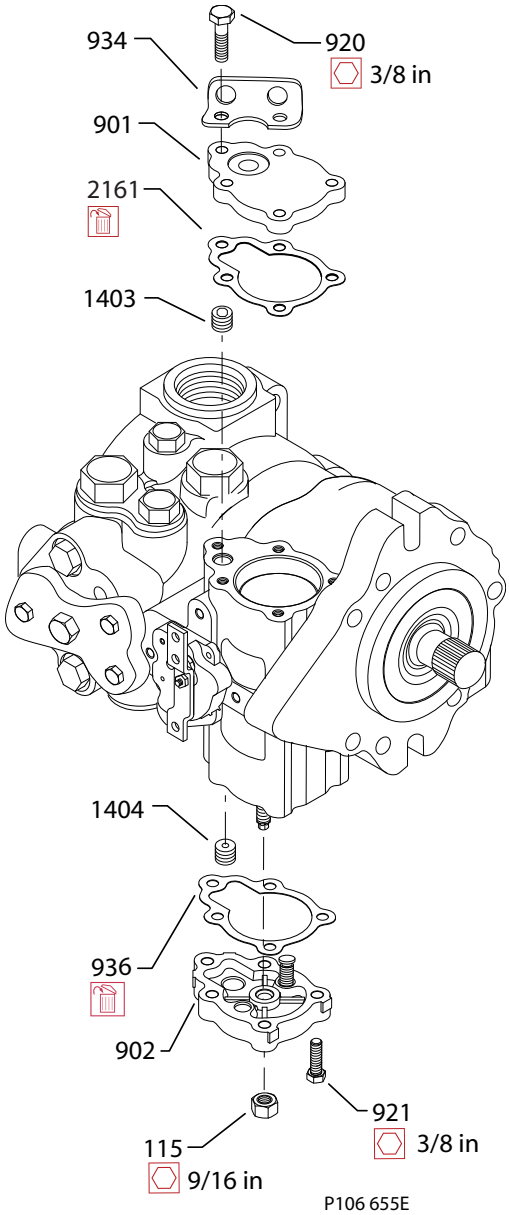
Clean orifice. Replace if necessary.

Reassembly

1. Using a 7/32 in. internal hex wrench, install orifice plugs (1403 and 1404). Torque to 3 N•m [2 lbf•ft].
2. Install servo covers. See *Displacement limiter* on page 25, for servo cover removal and installation instructions.

Minor repair

EDC/HDC orifice repair



Torque chart

Fastener size and torque chart

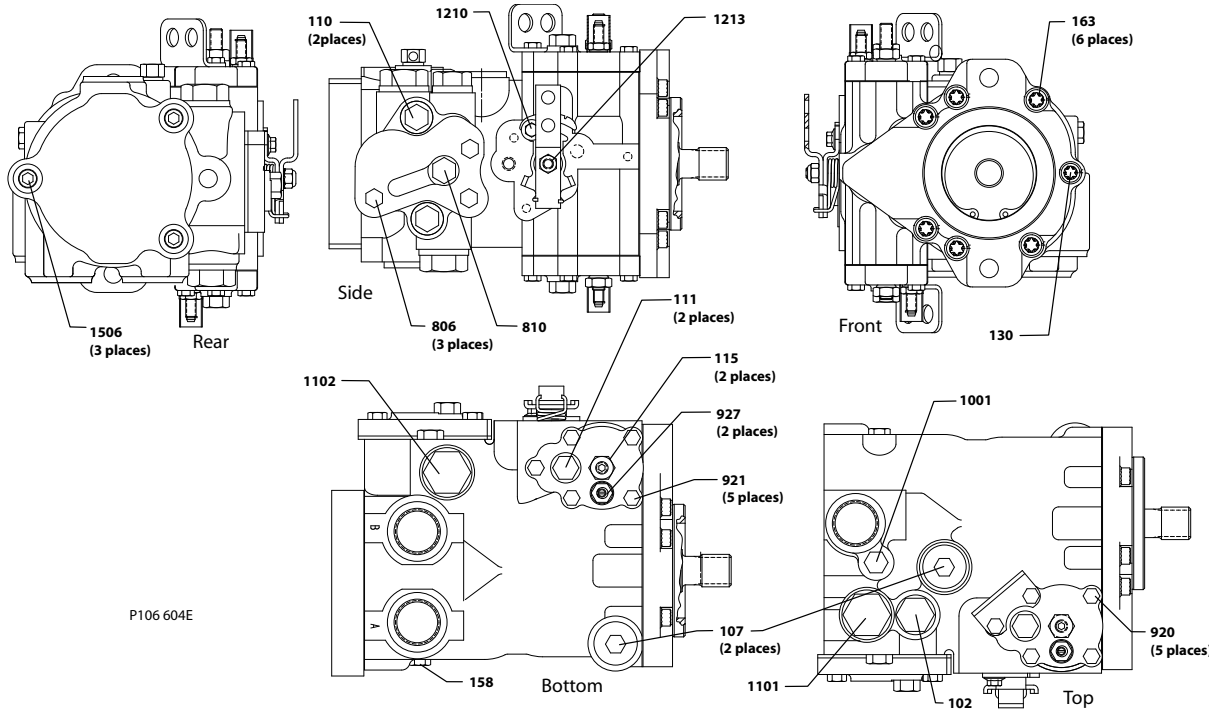
Item	Fastener	Wrench size	Torque
920	Servo piston cover screws	3/8 hex	15 N•m [11 lbf•ft]
921	Servo piston cover screws	3/8 hex	15 N•m [11 lbf•ft]
130	Front cover screw	T50 Torx	58 N•m [43 lbf•ft]
163	Front cover screws	T55 Torx	91 N•m [67 lbf•ft]
1506	Rear cover screws	9/16 hex	77 N•m [57 lbf•ft]
806	Filtration cover screw	1/2 hex	30 N•m [22 lbf•ft]
115	Lock/seal nut	11/16 hex	37 N•m [27 lbf•ft]
927	Displacement limiter lock/seal nut	9/16 hex	12 N•m [9 lbf•ft]
1213	Control handle nut	1/2 hex	15 N•m [11 lbf•ft]
1210	Screw	3/8	14 N•m [10 lbf•ft]

Plug size and torque chart

Item	O-ring plug	Wrench size	Torque
102	3/4 16 UNF	1 inch hex	108 N•m [80 lbf•ft]
107	1-1/16 12 UNF	9/16 internal hex	115 N•m [85 lbf•ft
110	9/16 18 UNF	11/16 hex	37 N•m [27 lbf•ft]
111	9/16 18 UNF	11/16 hex	37 N•m [27 lbf•ft]
158	7/16 20 UNF	9/16 hex	20 N•m [15 lbf•ft]
810	9/16 18 UNF	11/16 hex	37 N•m [27 lbf•ft]
1001	5/8 18 UNF	5/8 hex	20 N•m [15 lbf•ft]
1101	1-5/16 12 UNF	1-1/4 hex	176 N•m [130 lbf•ft]
1102	1-5/16 12 UNF	1-1/4 hex	176 N•m [130 lbf•ft]

Torque chart

Hardware locations



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www.daikin-sauer-danfoss.com

Local address:

Danfoss
Power Solutions US Company
2800 East 13th Street
Ames, IA 50010, USA
Phone: +1 515 239 6000

Danfoss
Power Solutions GmbH & Co. OHG
Krokamp 35
D-24539 Neumünster, Germany
Phone: +49 4321 871 0

Danfoss
Power Solutions ApS
Nordborgvej 81
DK-6430 Nordborg, Denmark
Phone: +45 7488 2222

Danfoss
Power Solutions
(Shanghai) Co. Ltd.
Building #22, No. 1000 Jin Hai Rd
Jin Qiao, Pudong New District
Shanghai, China 201206
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